Erosion and landform evolution of the Ethiopian highlands constrained by cosmogenic nuclides

R. PIK[1], J. LAVÉ[2] AND P.H. BLARD[1,3]

[1] CRPG, Nancy, France ; rpik@crpg.cnrs-nancy.fr
[2] LGCA, Grenoble, France
[3] CEREGE, Aix-en-Provence, France

One of the major geological event experienced by East Africa since Oligocene is represented by the emplacement of a thick CFB pile, before the development of the Red Sea - Ethiopian rift system and the collapse of the Afar depression. The morpho-tectonic evolution of this volcanic plateau by uplift and denudation along tectonic scarps (during subsequent extension) is debated, especially concerning the age of rift initiation.

Our approach, to better constrain the morphological evolution of this margin system, was to document the evolution of the associated landforms: especially the rates of erosion along regressive catchments as well as the preservation of the summit flat surfaces. For this, we have measured cosmogenic nuclides (^{3}He, ^{10}Be) in olivines and quartz from river detrital material and from exposed surfaces. The amount of cosmogenic nuclides contained in minerals, from the various morphological zones of the plateau, is very contrasted and allowed to derive erosion rates (from 8 to 200 m/Ma) which exhibit a good correlation with the fluvial relief of the catchments (see figure below).

Such a correlation allowed to (i) calibrate a shear-stress erosionnal model against these data, and (ii) to apply it to the whole plateau in order to derive a regional erosion map. These cosmogenic data and the derived erosion map yield new constraints for the Cenozoic evolution of the Ethiopian plateau, as well as for the recent acceleration of the erosion induced by anthropic actions.